Tool Box

Quick Reference Guide

Raypak Digital Gas Pool Heaters

WATER CHEMISTRY

(Corrosive water voids all warranties)

For your health and the protection of your pool equipment, it is essential that your water be chemically balanced. The following levels must be used as a guide for balanced water.

Recommended Levels	Fiberglass Pools	FiberGlass Spas	Other Pool & Spa Types
Water Temp. (Deg. F)	68 to 88	89 to 104	68 to 104
pH	7.3 to 7.4	7.3 to 7.4	7.6 to 7.8
Total Alkalinity (PPM)	120 to 150	120 to 150	80 to 120
Calcium Hardness (PPM)	200 to 300	150 to 200	200 to 400
Salt (PPM)	**6000 MAXIMUM**	**6000 MAXIMUM**	**6000 MAXIMUM**
Free Chlorine (PPM)*	2 to 3	2 to 3	2 to 3
Total Dissolved Solids (PPM)	**3000 MAXIMUM**	**3000 MAXIMUM**	**3000 MAXIMUM**

*Free Chlorine MUST NOT EXCEED 5PPM

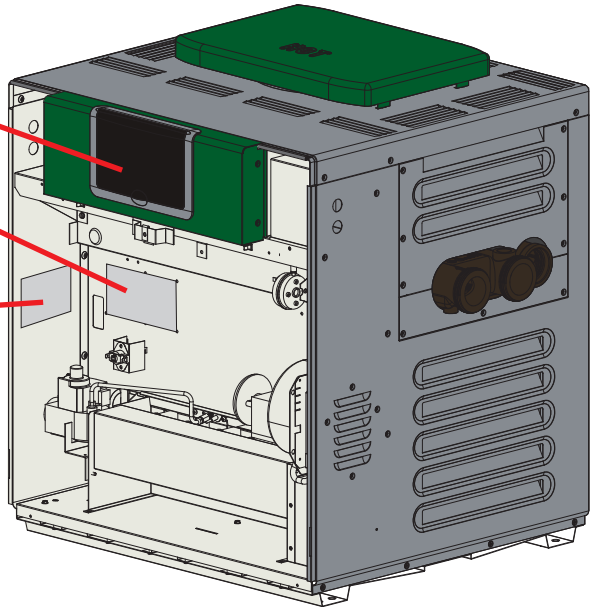
- Occasional chemical shock dosing of the pool or spa water should not damage the heater providing the water is balanced.
- Automatic chemical dosing devices and salt chlorinators are usually more efficient in heated water, unless controlled, they can lead to excessive chlorine level which can damage your heater.
- Further advice should be obtained from your pool or spa builder, accredited pool shop, or chemical supplier for the correct levels for your water

Model Number and Serial Number Location

Model & Serial number can also be found inside the control panel above digital display.

Model & Serial number located on rating plate.

Alternate location



Before you call Raypak service, make sure you have the MODEL NUMBER and SERIAL NUMBER.

Clearances - General

INDOOR

TOP: Drafthood - 30”
RIGHT SIDE: 12”
LEFT SIDE: 6”
FRONT: Alcove (Open)
BACK: 6”
FLOOR: 0”

OUTDOOR

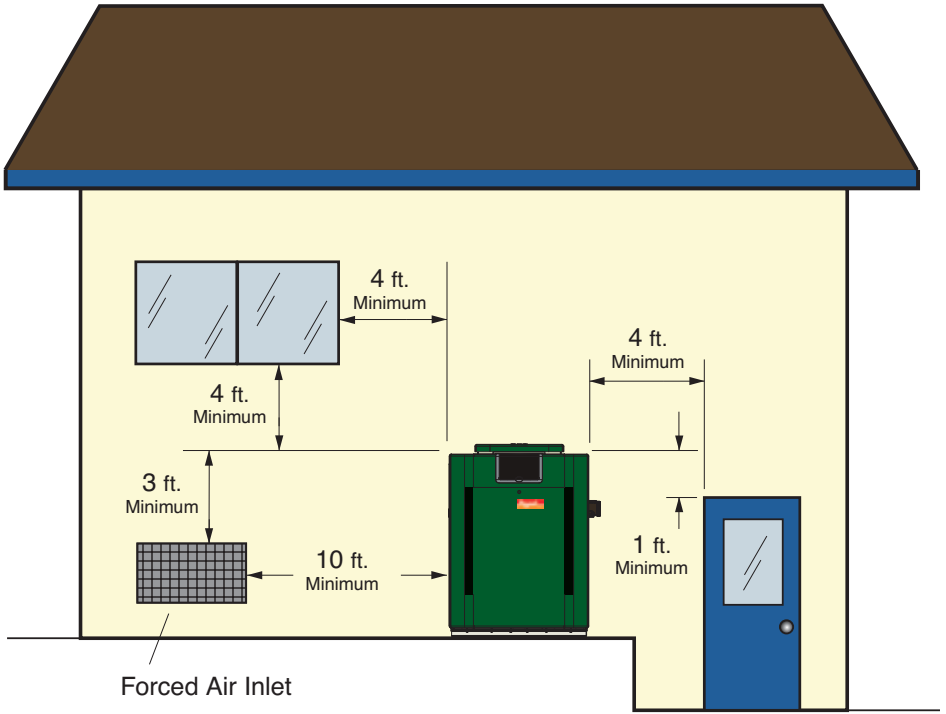
TOP: 36” (Stackless)
BACK: 6”
LEFT SIDE: 6”
RIGHT SIDE: 12”
FLOOR: 0”

FLOORING: THIS UNIT **CAN** BE INSTALLED ON COMBUSTIBLE FLOORING. DO NOT INSTALL ON CARPET.

Clearances - Outdoor

Do not install near sprinklers.

Do not install within 3 feet of a heat pump pool heater or air conditioning condensing unit.



Clearances -Indoor

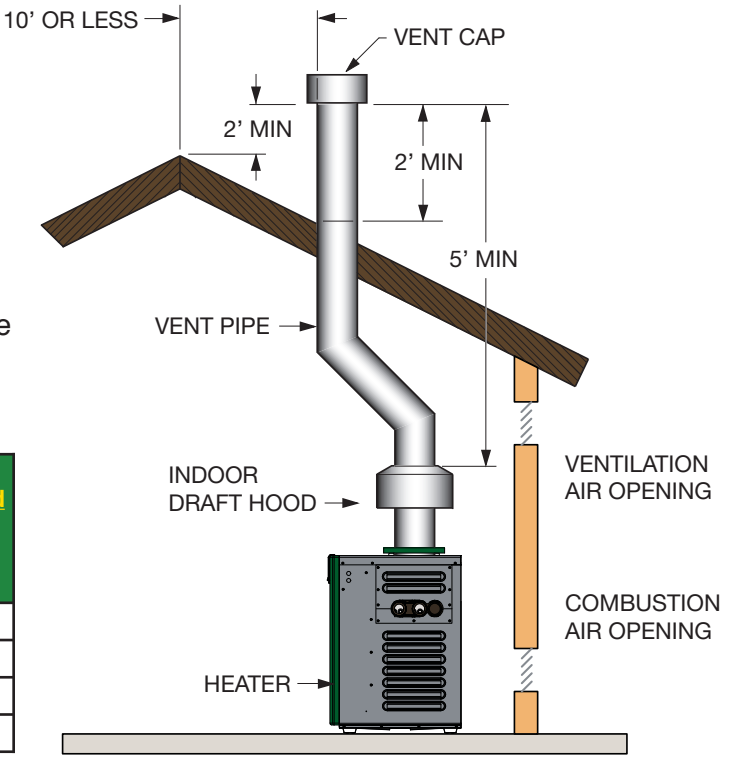
The heater must have **both** combustion and ventilation air.

- Ventilation air opening 12” from the ceiling
- Combustion air opening 12” from the floor

All air from outdoors, each opening shall have a net free area* as shown in table.

** Effective open area of louvers or screens*

Model	Unrestricted opening Sq. In. *	Typical Screened or Louvered opening Sq. In.	Typical Screened and Louvered opening Sq. In.
206/207	50	75	100
266/267	67	101	134
336/337	84	126	168
406/407	100	150	200



Check State and local codes before proceeding. Some States do not recognize the NFGC and require larger openings.

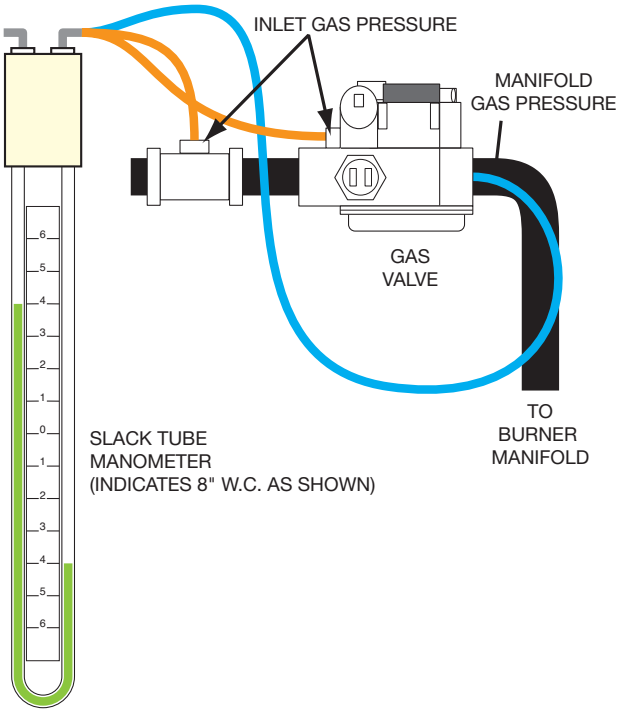
Gas Line Sizing

Maximum Equivalent Pipe Length									
Natural Gas 1000 BTU/FT^3 0.60 Specific Gravity @ 0.5 in. WC Pressure Drop									
Propane Gas 2500 BTU/FT^3 1.53 Specific Gravity @ 0.5 in. WC Pressure Drop									
	Input	3/4”		1”		1-1/4”		1-1/2”	
Model	(KBTU)	N	P	N	P	N	P	N	P
206/207	199.5	25	60	90	215	360			
266/267	266.0	15	35	50	125	210	480	445	
336/337	332.5	10	20	30	80	140	320	290	
406/407	399.0		15	20	55	95	225	215	480

Effects of low gas pressure:

Pulsating burner flame • Delay Ignition/Hard light off • Pilot won’t light
Exposure to condensation • Emissions not at compliance levels
Damage to Low NOx burners

Gas Pressure Test



Gas	Unit Type	Supply Press		Man Press
		Min.	Max.	
Nat	ATM	7”	14”	4.0”
	NOx	7”	14”	3.1”
Pro	ATM	12”	14”	10.5”

•Supply pressures given are under load (dynamic)

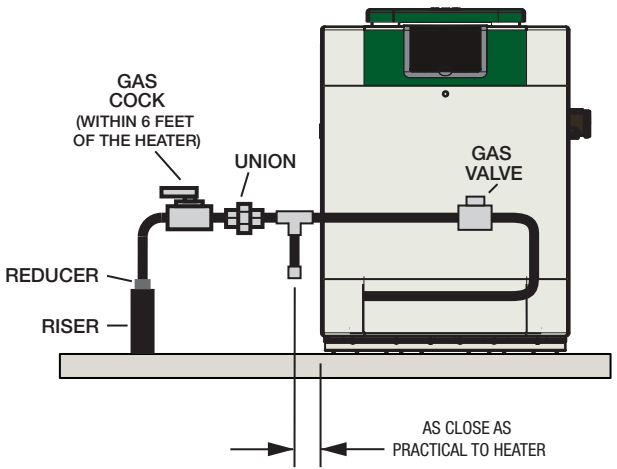
• 1 PSI = 27.7” Water Column

• Propane requires an external “pounds to inches regulator”

Gas Line Sediment Trap

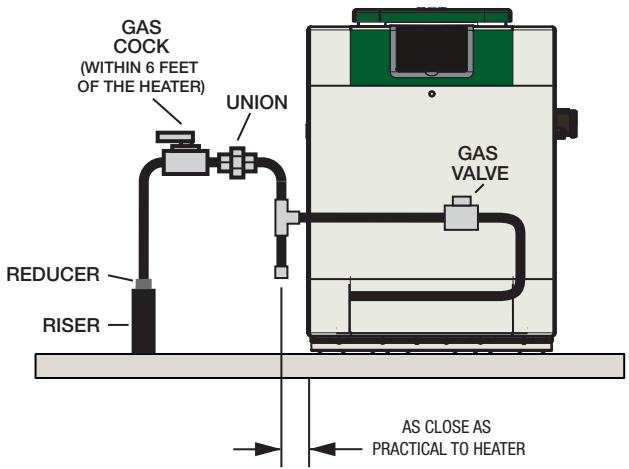
Sediment Trap should be located as close to the inlet of the appliance as practical.

INCORRECT



CORRECT

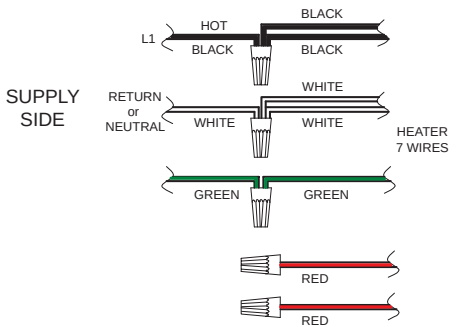
PROVIDE CHANGE OF DIRECTION IN GAS FLOW



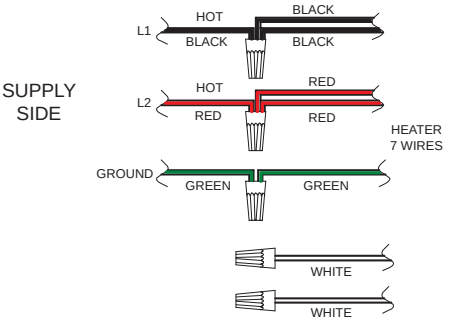
Check State and local codes before proceeding. Some States do not recognize the NFGC.

Power Connections

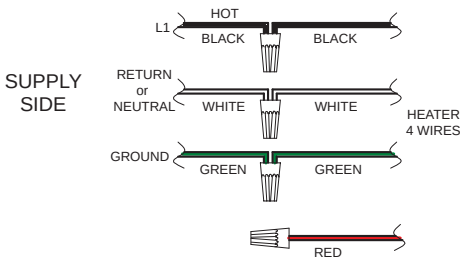
120V Lo NO_X HEATER



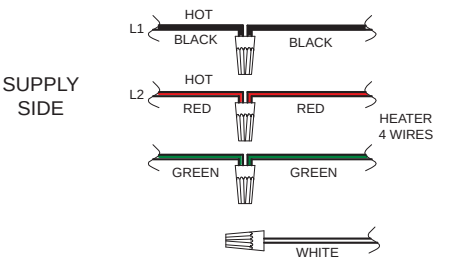
240V Lo NO_X HEATER



120V ATMOSPHERIC HEATER

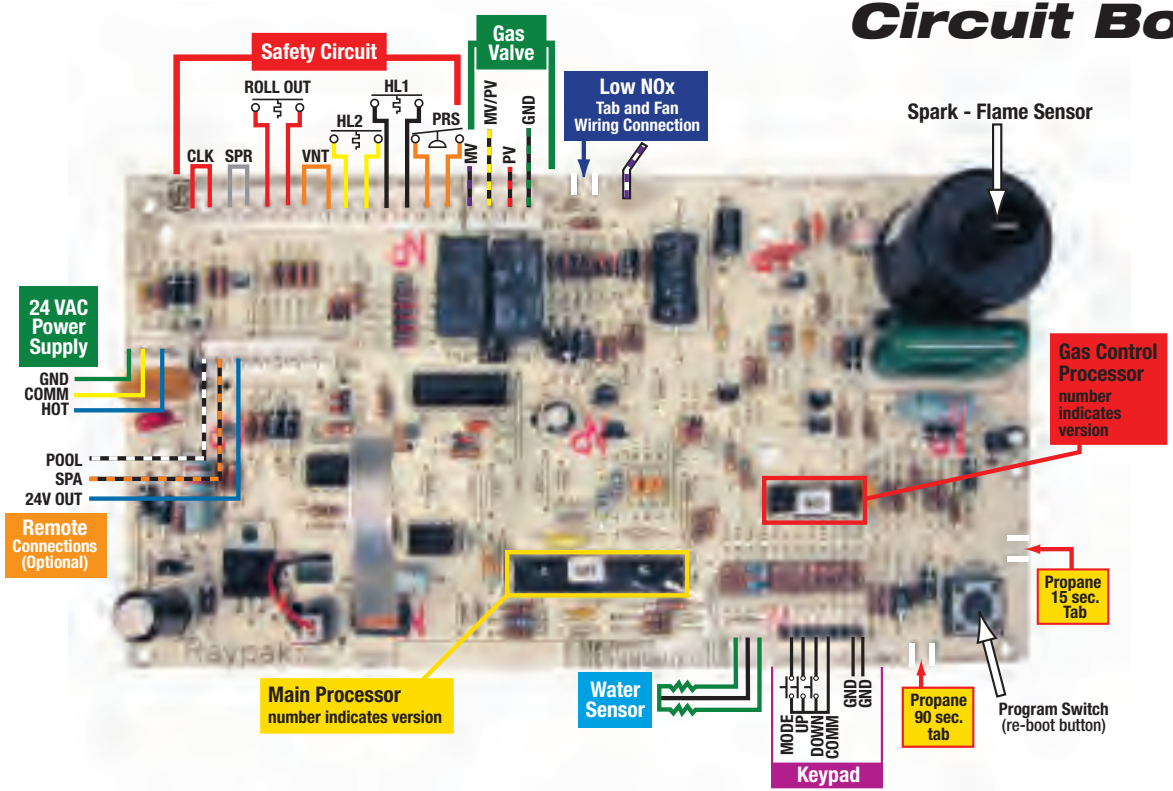


240V ATMOSPHERIC HEATER



Note: Heater <u>will not</u> work properly if wired to a 208VAC power source.

Ignition and Temperature Control
Circuit Board



Sequence of Operations

SUPPLY (Power to Heater)

1. 120/240 VAC from circuit breaker/time clock
2. 24 VAC out of transformer, toggle switch ON
3. 24VAC to MAIN PROCESSOR, LCD ON

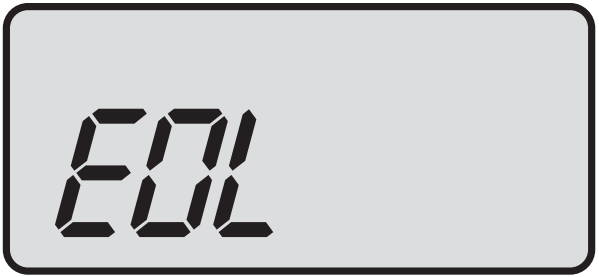
APPLY 24 VAC to GAS PROCESSOR

1. CFH (CALL FOR HEAT) - POOL/SPA selected, Temperature Set, THERMOSTAT CLOSED
2. SAFETY CIRCUIT COMPLETED
   (Pressure Switch, 2 High Limit Switches, Rollout Sensor CLOSED)
3. " SPK" indicates POWER to GAS PROCESSOR

REPLY (Spark & 24VAC to Gas Valve)

1. Gas Processor replies with SPARK and PILOT voltage (Inner flame icon appears).
   Pilot valve open, Gas supplied to pilot.
2. SPARK ignites pilot. Flame sensing occurs.
3. Gas Processor supplies voltage to close the Fan relay (Low NOx), FAN energizes, 30 seconds until FAN proves, MV energized.
4. Normal operating display w/outer flame icon flashing, Main Valve Open,
   2 Final pulses of Spark, Heater Fired.

EOL -Screen



EOL stands for End of Line Test. This is a factory test procedure mode used when doing the final live fire test at the factory. This mode is not used for field purposes.

To get a heater to display this mode, the unit must be off. Push and hold down the MODE button. While holding down the button, turn the power on. EOL will appear. To eliminate the EOL mode, turn the power off and then back on.

If the EOL mode returns, it is most likely a bad keypad. To determine if the keypad is bad, turn power off. Unplug keypad connector from circuit board. Power unit on. If board goes into normal operation, the keypad is bad. If EOL still appears, replace the board.

BDI -Screen

BDI

BDI is an indication of main board failure.

If this code appears and stays on, turn off power to board at toggle switch and source, then re-establish power.

If code reappears, replace board as the main processor failed to start.

EEP -Screen

EEP means there is a problem accessing the memory chip.

EEP

EEP indicates that memory failed to start on main processor. And the main processor can’ t execute the program with the supplied data.

Turn off power at toggle switch and source and re-establish power.

If code reappears, replace board as memory has failed.

BOARD ONLY REMEMBERS MODE,TEMPERATURE AND FAULTS.

PRS -Screen

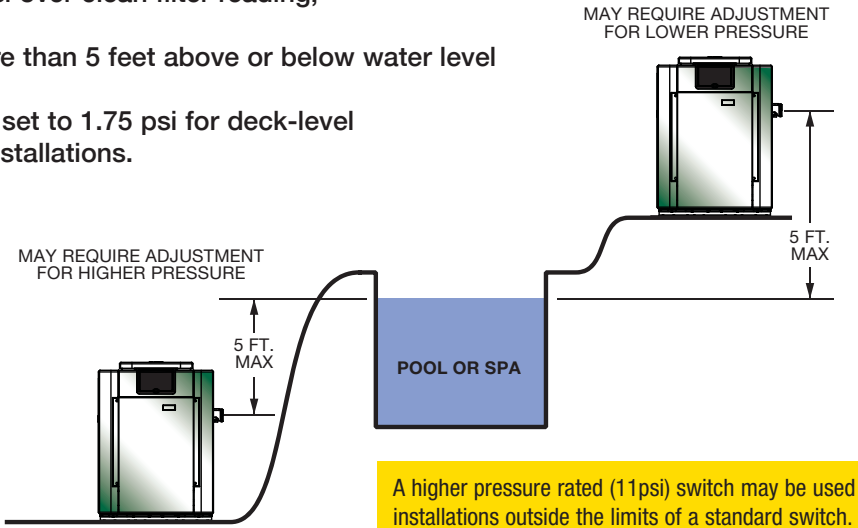
PRS

PRS indicates low water pressure at the heater.

1. Indicates possible low water flow through heater.
2. Check water level at skimmer face, should be middle of skimmer face.
3. Check pump – is it running.
4. Check filter pressure – if 10 psi over clean filter reading, backwash filter.
5. Check heater location – if more than 5 feet above or below water level – adjust pressure switch.
6. The pressure switch is factory set to 1.75 psi for deck-level and 5 feet below water level installations.

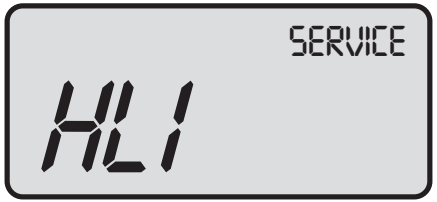
Part Number 006737F

Pressure Switch



A higher pressure rated (11psi) switch may be used for installations outside the limits of a standard switch. Use part number 009133F

HL1 & HL2 -Screen

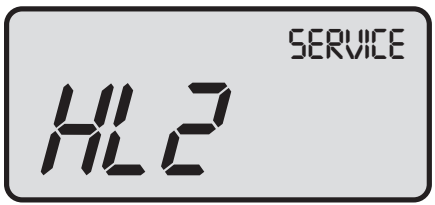


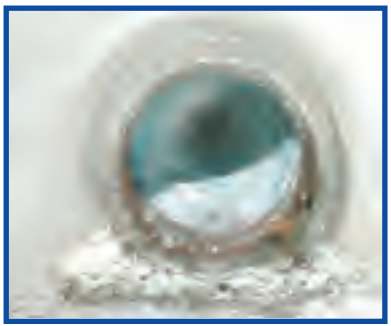
HL1 & HL2 indicate the high-limit has exceeded 135F.

1. Possible excessive water temperature in the tube bundle.
2. Once heater cools, high limits will reset automatically.
3. Check for blockage in tubes.
4. Check for low water flow.
5. Check UG – replace if necessary.
6. Check bypass assembly- replace spring or bypass if necessary.

Part Number 006725F

Hi Limit Switch





Limed Tube

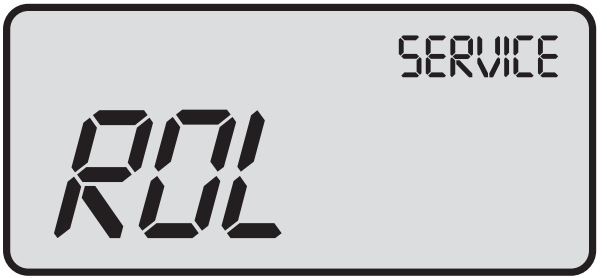
Part Number 006719F

Unitherm Governor

ROL -Screen

ROL means the thermal fuse has tripped inside the heater. This only trips when excessive heat or flame roll-out is detected.

1. Indicates possible downdraft of burner flame.
2. If sensor has red reset button, press button and determine cause.
3. Does the unit need an outdoor high wind stack?
4. Check all wiring for indication of burnt wires, especially the green ground wire and wires at gas valve.
5. Replace wires as necessary.

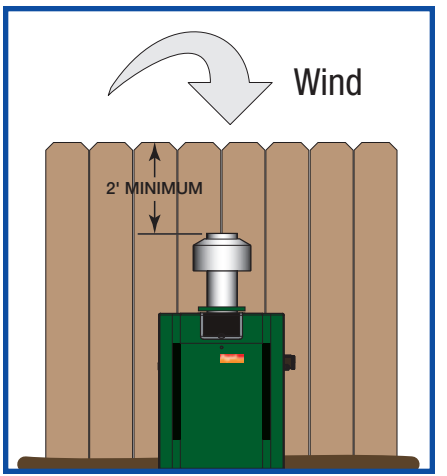


Part Number 005899F

ATM Rollout Fuse

Part Number 006035F

Low NOx Rollout Switch

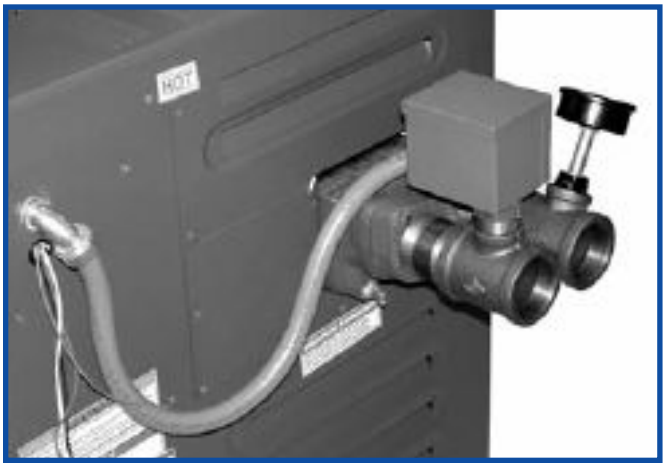


Wind defense - high wind stack

SPR -Screen

1. Used with flow switch for Texas Code Kit (see below).
2. Failure of flow switch will show as SPR.

Note:
This is a " spare" fault code. This connection comes from the factory with a jumper wire. Any field installed safety device such as a flow switch, draft proving switch or special hi-limit can be wired to this contact.



SPR

SNS -Screen

SNS indicates the temp sensor is out of acceptable range.

1. Water temperature is below 36 ° F or above 110 ° F.
2. The sensor contains two thermistors. If they are more than 2 degrees apart an SNS failure will occur.
3. Loose or corroded connection at P1.
4. If the sensor is not mounted all the way into the JACO fitting on the header it may give a false reading.

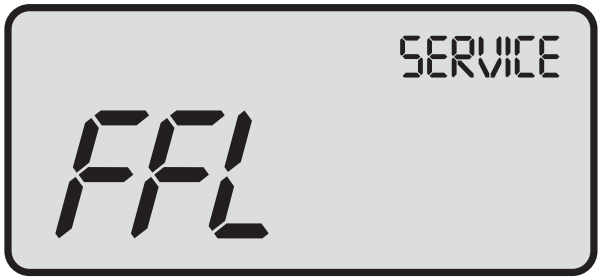
SNS

Sensor resistance at various temperatures								
Temp Degrees F	40	50	60	70	80	90	100	106
Resistance (k)	261.1	199.0	153.1	118.8	93.0	73.3	58.3	51.0

Replace sensor if not within 10% of values shown

Water Sensor - 100k Ohm

FFL -Screen



Indicates flame signal sensed at PILOT before SPARK initiated and pilot established. FFL indicates a False Flame Signal.

1. Check to see if pilot is staying lit after CFH is satisfied (main burner off). If pilot is staying lit, the pilot valve in the gas valve is hanging open. Replace the gas valve.
2. If the gas valve is working properly, than the problem lies with the pilot system or board. Turn power off at toggle switch.
3. Unplug the **IGNITION WIRE** from the board and pilot (if low NOx) and remove the **GREEN** ground wire from burner tray, clean and reconnect ground wire.
4. Turn power on - if no Spark is observed at the Ignition Module, turn off power and replace the BOARD and reconnect the ignition wire.
5. If Spark is observed at the Ignition Module, turn off the power and reconnect the Ignition Wire.
6. Turn power on and unit should fire.

GVO & GVC -Screen

Indicates power found at either PV or MV at the incorrect time (GVO), or if no power is detected at PV or MV when commanded (GVC)

1. Turn OFF power and disconnect Ignition Wire and Gas Valve wires from Board.
2. Turn power ON and WATCH for Spark at module.
3. If no Spark is observed, turn OFF power and REPLACE the BOARD.
4. If Spark is observed, turn off power and reconnect Gas Valve and Ignition wire.
5. Turn ON power and unit should fire.
6. If unit does not fire and code reappears, turn off power and disconnect Gas Valve wires from the Board and remove **MV**, **PV** and **GROUND** wires from the Gas Valve. Clean and reconnect the wires.
7. Plug the Gas Valve back into the Board and turn the power ON. The unit should fire.
8. If the unit fails to fire, REPLACE THE GAS VALVE

GVO/ GVC

CHECK INCOMING POWER - Low power (208-220VAC) to the transformer can cause a GVO fault.

Fan -Screen
Low NOx Units

Indicates that the Pilot was lost, or the air pressure switch is not closed when required. On units with serial numbers 0707... or older, Fan typically indicates loss of PILOT during MV operation. Units newer than 0707 typically indicate Air Pressure Switch failure.

1. Check for correct incoming power at the fan relay – 120V or 240V and at the fan motor.
   Note: Fan <u>will not</u> operate properly on 208V. Fan is wired before the transformer and can receive either 120/240VAC *(you can wire directly to the fan motor to check for proper operation of the fan)*.
2. If pilot has been confirmed, check for 24 volt minimum out of fan relay to air pressure switch.
3. If power is confirmed at the air pressure switch (purple wires) but the switch does not make when the fan is operating, verify that the tubing between the fan housing and switch is connected and is not kinked. If the switch remains inoperable, turn off power and replace the air pressure switch with the correct setting for the unit (see page 38).
4. Restore power and wait for unit to start.
   Note: Circuit board checks for pressure switch closure 30 seconds after MV is powered.
5. Soft lock out after 3 attempts, automatically resets after 5 minutes.

Tech Tip: The air pressure switch senses negative pressure (suction). Testing the air switch by blowing on it will not

FAN/TAB Alternating Code -See TAB 2 screen

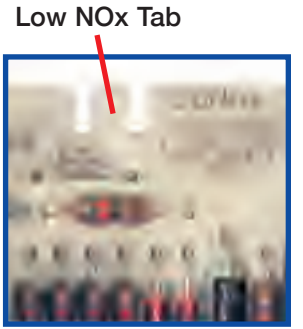
Air Pressure Switch

Blower/Fan

TAB -Screen

TAB indicates that either the board TAB for Low Nox has not been broken, tab failed to break off correctly or the air pressure switch failed or is not connected.

1. Check to make sure the White/Purple wire is secure on male low NOx connector on PC board.
2. Check to make sure the wire is secure on the air pressure switch.
3. Turn off power to the board via the toggle switch.
4. Unplug the gas valve connector and ignition wire from the board.
5. Turn on power to the board and listen for spark at the ignition module.
6. If the board is sparking, turn off power and replace the air pressure switch with correct setting switch for the unit (see page 38).
7. Plug in the gas valve connector and the ignition wire to the ignition module.
8. Turn on the toggle switch and wait for the unit to start.



TAB
1

FAN/TAB Alternating Code & TAB Code Atmospheric-See TAB 2

TAB -Screen

FAN/TAB Alternating Code – When these two codes alternate back and forth with each restart, they indicate a moisture condition within the Air Pressure Switch (APS). Disconnect the APS and turn the switch so the air tube adapter is pointing downward. Take note of any water flowing from the inside of the switch. Replace the switch and reconnect all wiring and the orange air tubing, turn the heater back on.

TAB Code Atmospheric – Raypak uses one board for Low NOx, Atmospheric and Propane units. Replacement boards have a white/purple wire attached to the P-10 (Low NOx) plug extension. This wire pigtail should be removed on all atmospheric and propane units as it is capable of receiving energy from the spark wire at time of ignition. This will result in a false TAB code, because these units are not Low NOx. On Low NOx units the existing white/purple wire from the APS would be reattached to this terminal if a board replacement is necessary.

IGN -Screen

IGN stands for Ignition Failure.

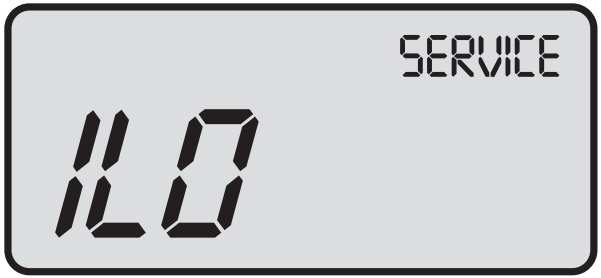
Indicates loss of flame signal at the pilot after main gas valve power has been applied. The board will reset itself and make three attempts on same CFH.

If the unit fails to hold flame after three attempts, it will go into a hard lockout. Interrupt the power supply to clear the lock out and check for air in the gas line or not enough gas pressure.

IGN

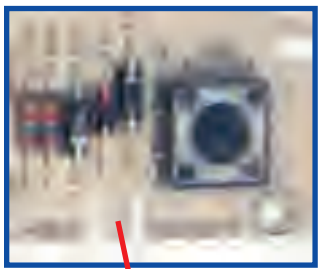
IGN only appears after pilot has proved and main valve has been powered.

ILO -Screen



ILO means Ignition Lock Out. This only applies to propane units.

PROPANE - ILO is an indication that unit failed to light the pilot within the 90 second trial for ignition.



Propane Tab
90 sec.

Interrupt power to override the lock out. Check for air in the gas line or low gas pressure.

If the propane tank is less than half full, there may not be enough gas pressure.

REPLACEMENT BOARDS MUST BE SET FOR PROPANE USE. THE 90 SECOND TAB MUST BE BROKEN.

Tech Tip: The most common cause for an ILO fault is an

CLK -Screen

CLK

CLOCK - Time Clock
Heater is OFF by programmed control of a TIME CLOCK.

Time Clock

If a FIREMAN' S SWITCH is connected, this display is NORMAL, indicating TIME CLOCK has turned the heater OFF 10-20 minutes prior to turning the pump OFF. This is also referred to as a " cool down cycle" .

It is not unusual to see a remote wired into this connection. This was common many years ago before heaters had dedicated remote connections.

Remote Wiring

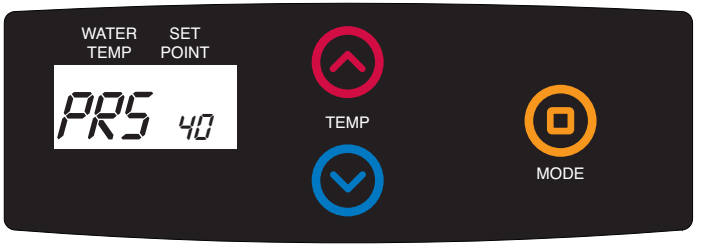
7-Pin Remote Wire Harness

Wire Harness Connected to Board

REM

1. Pre-set Pool and Spa set point temperature.
   (Set at 104°F if remote controller has built in T-Stat)
2. Select OFF Mode on control panel.
3. Remove Power; Connect the remote to the 7 pin remote wire harness. Plug the wire harness into the board. Re-apply power.
4. Hold all three buttons on the control panel down for 5-7 seconds until REMon appears. This will enable the remote and disable the touch pad.

Fault History File



The most recent service displays (up to 40) are retained in the memory of the control.

1. Select OFF using Mode button.
2. Hold both Temp Set arrows down 6-7 seconds until the display reads most recent fault code.
3. The display indicates the number of failures recorded (40 max).
4. Use the Temp Set arrows to scroll through recorded faults.

Service codes will display for about 6 seconds before reverting back to normal display.

Program Button

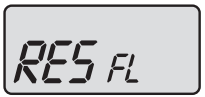
Allows for custom software adjustments to meet job site needs.

To initiate programming mode:

1. Select OFF Mode
2. Hold Program Button 5-7 seconds until " SETdef" appears.
3. Press the Mode Button sequentially until the desired program event is reached.
4. There are 5 events that can be programmed.

Resets board to factory default settings

When **SETdef** appears on the screen press and hold both UP and DOWN buttons for 5-7 seconds until 3 dashes (---) appear. Both pool and spa set points revert to 65F.



Resets faults in history file

When **RESfl** appears on the screen press and hold both UP and DOWN buttons for 5-7 seconds until 2 dashes (--) appear. This clears fault history to "0".

Change from Fahrenheit to Celsius

When **F/Cfff** appears on the screen press the UP or DOWN button to toggle between "F" or "C".

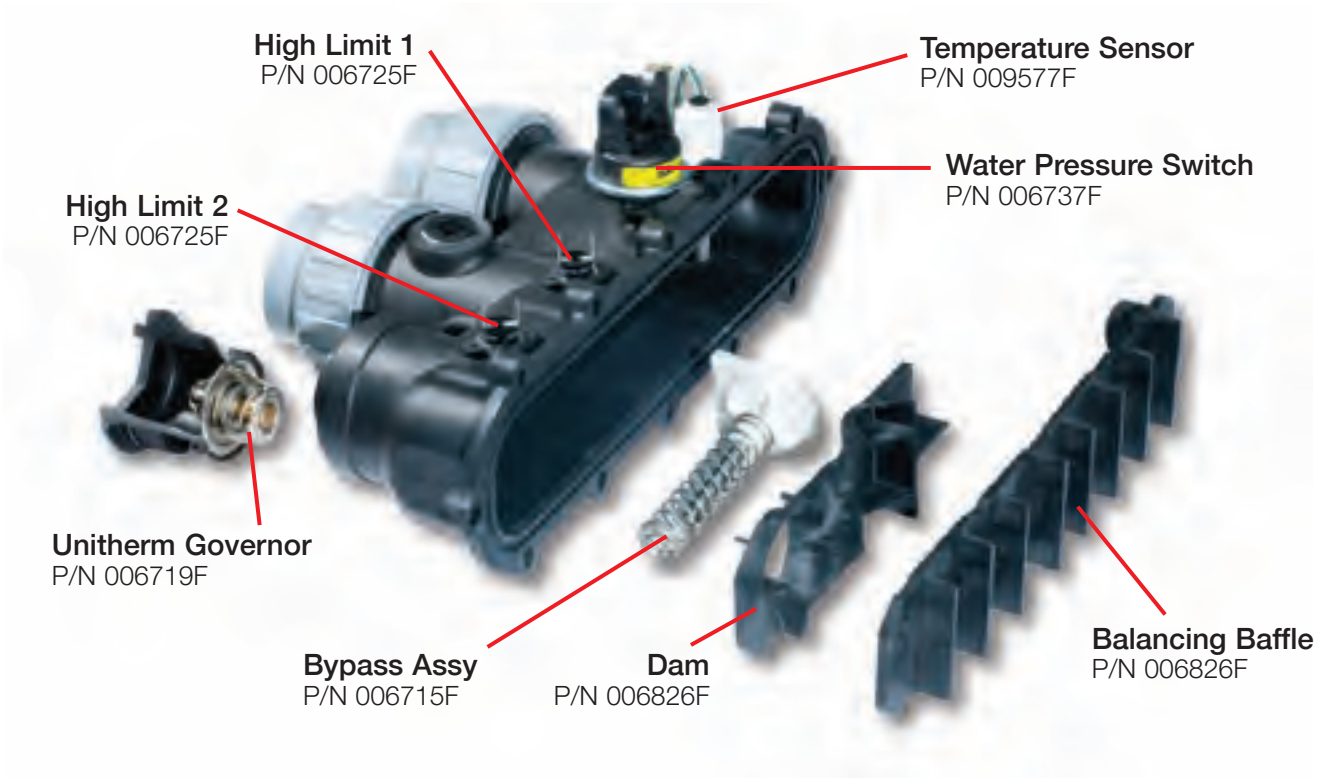
SPA- Set maximum set point

When **SETspa 104** appears on the screen press the UP or DOWN button to your desired maximum temperature setting. The control can be set for a maximum of 107F.

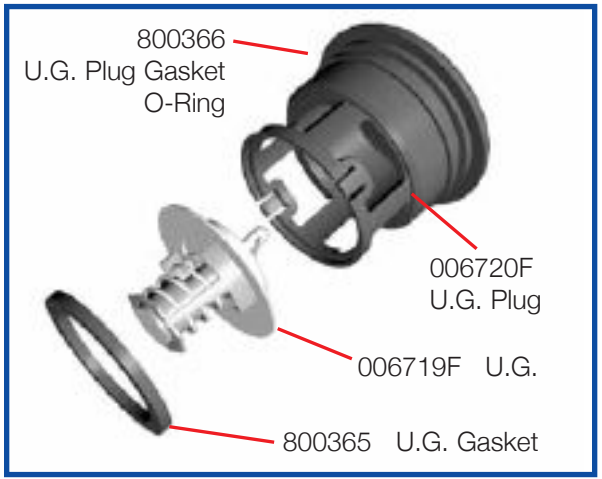
POOL- Set maximum set point

When **SETpool 104** appears on the screen press the UP or DOWN button to your desired maximum temperature setting. The control can be set for a maximum of 107F.

Inlet-Outlet Header



Unitherm Governor



The UNITHERM GOVERNOR helps prevent condensation and scale. It is a thermostatic mixing valve used to control and regulate the water temperature in the heat exchanger.

Low temperatures in the exchanger can cause condensation. This indicates that the heat exchanger is running cool. This may be caused by too much flow. Make sure the pump is not supplying more than 125GPM. Also check the U.G. to make sure it is working properly and not damaged from chemical cor-

Elevated temperatures can cause scale. This may also produce a knocking sound and high limit cycling. Make sure there is enough flow through the heater. Minimum flow rate is 20-40GPM depending on model size. Also check and make sure the automatic bypass is not missing or broken. Check the Unitherm Governor and make sure it is not frozen in one position or chemically damaged. Tech Tip: You can test a U.G. by placing it in a cup of hot water and watching it open up.

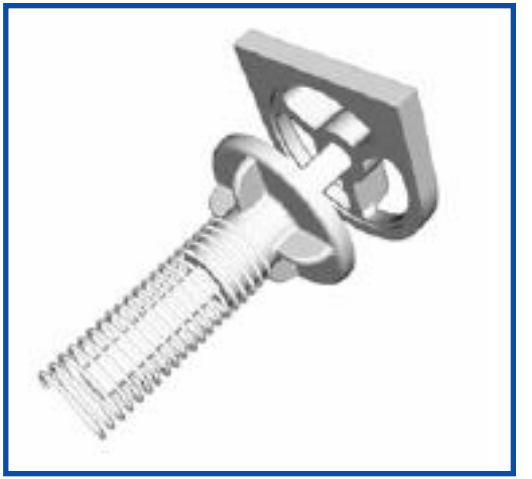
Internal Bypass Valve

The Automatic Bypass Assembly allows the heater to be connected to a wide variety of pumps.

With every job site having different flow rates, the Bypass automatically adjusts to provide the proper flow rate to the heater, up to 125GPM max. If the flow rate exceeds 125GPM condensation may form and erosion of the copper tubes may occur. It is then recommended that an external bypass be installed before the heater.

If the heater is making a knocking noise or cycling the high limits, it may be that the Bypass is missing, stuck open or damaged. It is also possible that the wrong Bypass spring is installed. See table for correct

	206/207	266/267	336/337	406/407
Color	Blue	Red	Silver	Silver
Part Number	006718F	006718F	006718F	006718F



Tech Tip:
You can feel the Bypass by placing your fingers down into the inlet of the header. You can feel the Bypass spring back as you push on it.

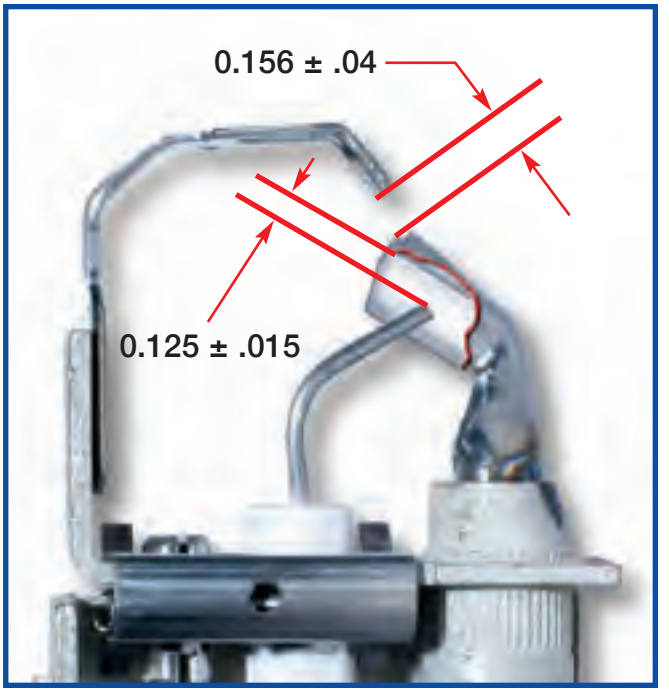
Flow Rates and Pressure Drops

Polymer Header (Standard Models)				
Plastic Internal Baffle - Manufactured after 11/08				
Flow GPM	Pressure Drop (Ft of Head)			
	206/207	266/267	336/337	406/407
20	4.0			
25	4.0	4.6		
30	4.0	5.2		
35	4.0	5.8	5.2	
40	4.6	5.8	5.2	5.2
50	4.6	6.3	6.9	6.9
60	4.6	6.9	6.9	6.9
70	4.6	8.1	9.2	9.2
80	4.6	9.2	9.8	9.8
90	6.9	10.4	10.4	10.4
100	8.1	11.0	12.1	12.1
110	10.4	11.5	13.3	13.3
120	11.0	12.7	17.9	17.9
125	11.5	13.8	20.2	20.2

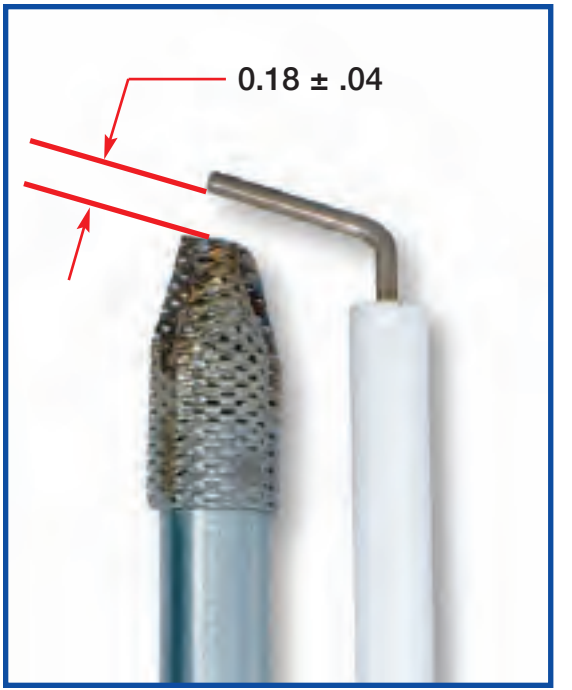
Cast Iron Header (ASME Models)				
Flow GPM	Pressure Drop (Ft of Head)			
	206/207	266/267	336/337	406/407
20	1.8			
30	2.2	8.0		
40	2.5	9.0	9.0	9.0
50	2.7	9.8	9.8	9.8
60	3.3	10.5	10.5	10.5
70	4.3	11.0	11.0	11.0
80	5.5	11.5	11.5	11.5
90	6.8	14.0	14.0	14.0
100	8.2	17.0	17.0	17.0

Flow Rates		
Model	Min GPM	Max GPM
206/207	20	125
266/267	25	125
336/337	35	125
406/407	40	125

Pilot Assemblies -Spark Gap



Atmospheric Pilot



Low NO_X Pilot

PRV Installation

This photo illustrates the correct installation of a PRV on the larger models.

Two street elbows are used to move the larger PRV' s away from the access panels. Smaller PRV' s can be mounted directly into the header.

Low NOx Air Pressure Switch

There are 4 different air pressure switches for the Low NOx heaters. None of the switches are interchangeable.

Each switch has a colored decal to help identify the switch. See chart below for proper switch choice.

Tech Tip: The air pressure switch senses negative pressure (suction). Testing the air switch by blowing on it will not work. You need to apply light suction.

	207	267	337	407
Color	Blue	Red	Yellow	Green
Part Number	008062F	008135F	010354F	010355F

Notes

Tool Box
Quick Reference Guide

WWW.RAYPAK.COM

Check our FAQ section on our website for answers to common problems.
EMAIL us with technical questions, we pride ourselves on quick answers.

BEFORE YOU CALL

What is the incoming power 120 or 240VAC? 208 will not work properly.
What is the power at the circuit board?
What is the incoming gas pressure?
If the unit can fire, what is the pressure at the manifold (burner pressure)?
Is the gas line rigid or flex-line?

THIS IS NOT A SUBSTITUTE FOR THE INSTALLATION AND OPERATION MANUAL.
THIS MANUAL IS INTENDED TO HELP THE SERVICE TECHNICIAN WITH BASIC TROUBLESHOOTING.

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